WHAT IS CLAIMED IS:

1. A catoptric projection optical system for projecting a reduced size of a pattern on an object surface onto an image surface and for serving as an imaging system that forms an intermediate image between the object surface and image surface, said catoptric projection optical system comprising six or more mirrors,

wherein a position of an exit pupil with respect to the intermediate image is located between the object surface and image surface, and

wherein the largest angle between principal rays and an optical axis for angles of view at the position of the exit pupil is $\sin^{-1}NA$ or smaller, where NA is a numerical aperture at the side of the image surface.

2. A catoptric projection optical system according to claim 1, wherein the numerical aperture is greater than 0.2.

3. A catoptric projection optical system according to claim 1, wherein the mirror that forms the intermediate image is located at a position of an aperture stop.

4. A catoptric projection optical system according to claim 1, wherein the intermediate image is formed on an optical path between a second mirror from the object surface, and a second mirror from the image surface.

5. A catoptric projection optical system according to claim 1, wherein the principal ray for each angle of view at the position of the intermediate image goes away from the optical axis.

6. A catoptric projection optical system according to claim 1, wherein the six or more mirrors form a coaxial system.

7. A catoptric projection optical system according to claim 1, wherein all of the six or more mirrors are aspheric mirrors including a multilayer coating that reflect light having a wavelength of 20 nm or smaller.

8. A catoptric projection optical system according to claim 1, wherein a reflection mask is arranged on the object surface.

9. A catoptric projection optical system according to claim 1, wherein said catoptric projection

optical system is non-telecentric at a side of object surface.

10. A catoptric projection optical system according to claim 9, wherein light incident upon a first mirror on an optical path from the object surface has an incident angle between 5° and 10°.

11. A catoptric projection optical system according to claim 1, wherein an exposure area at a side of the image surface has a slit width of 0.8 mm or greater.

12. A catoptric projection optical system according to claim 1, wherein said catoptric projection optical system includes, in order of sequential reflections of light from the object surface, a first mirror, a second mirror, a third mirror, a fourth mirror, a fifth mirror, and a sixth mirror,

wherein the second mirror, the first mirror, the sixth mirror, the third mirror, and the fifth mirror are arranged in this order from the object surface to the image surface, and

wherein said catoptric projection optical system forms the intermediate image between the second mirror and the third mirror.

13. A catoptric projection optical system according to claim 1, wherein said catoptric projection optical system includes only six mirrors or reflective surfaces.

14. An exposure apparatus comprising:

a catoptric projection optical system for projecting a reduced size of a pattern on an object surface onto an image surface and for serving as an imaging system that forms an intermediate image between the object surface and image surface, said catoptric projection optical system including six or more mirrors, wherein a position of an exit pupil with respect to the intermediate image is located between the object surface and image surface, and wherein the largest angle between principal rays and an optical axis for angles of view át the position of the exit pupil is $\sin^{-1}$NA or smaller, where NA is a numerical aperture at the side of the image surface;

a mask stage that supports a mask having the pattern, and positions the pattern on the mask onto the object surface;

a wafer stage that supports an object having a photosensitive layer, and positions the photosensitive layer on the image surface; and

a mechanism for synchronously scanning said mask stage and said wafer stage while the mask is

illuminated by light having a wavelength of 20 nm or smaller.

15. An exposure apparatus comprising:

an illumination optical system for illuminating a pattern with light from a light source; and

a catoptric projection optical system for projecting a reduced size of the pattern on an object surface onto an image surface and for serving as an imaging system that forms an intermediate image between the object surface and image surface, said catoptric projection optical system including six or more mirrors, wherein a position of an exit pupil with respect to the intermediate image is located between the object surface and image surface, and wherein the largest angle between principal rays and an optical axis for angles of view at the position of the exit pupil is $\sin^{-1}NA$ or smaller, where NA is a numerical aperture at the side of the image surface.

16. An exposure apparatus according to claim 15, wherein said projection optical system projects light reflected on the pattern, onto the image surface.

17. A device fabricating method comprising the steps of:

exposing an object using an exposure apparatus; and

developing the object that has been exposed,

wherein said exposure apparatus includes:

a catoptric projection optical system for projecting a reduced size of a pattern on an object surface onto an image surface and for serving as an imaging system that forms an intermediate image between the object surface and image surface, said catoptric projection optical system including six or more mirrors, wherein a position of an exit pupil with respect to the intermediate image is located between the object surface and image surface, and wherein the largest angle between principal rays and an optical axis for angles of view at the position of the exit pupil is $\sin^{-1}NA$ or smaller, where NA is a numerical aperture at the side of the image surface;

a mask stage that supports a mask having the pattern, and positions the pattern on the mask onto the object surface;

a wafer stage that supports an object having a photosensitive layer, and positions the photosensitive layer on the image surface; and

a mechanism for synchronously scanning said mask stage and said wafer stage while the mask is illuminated by light having a wavelength of 20 nm or smaller.

18. A device fabricating method comprising the steps of:

exposing an object using an exposure apparatus; and

developing the object that has been exposed,

wherein said exposure apparatus includes:

an illumination optical system for illuminating a pattern with light from a light source; and

a catoptric projection optical system for projecting a reduced size of the pattern on an object surface onto an image surface and for serving as an imaging system that forms an intermediate image between the object surface and image surface, said catoptric projection optical system including six or more mirrors, wherein a position of an exit pupil with respect to the intermediate image is located between the object surface and image surface, and wherein the largest angle between principal rays and an optical axis for angles of view at the position of the exit pupil is $\sin^{-1}NA$ or smaller, where NA is a numerical aperture at the side of the image surface.